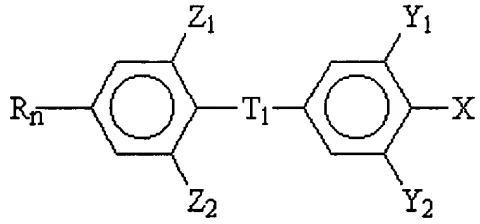
CLAIMS

What is claimed is:

1. Liquid crystal compounds having the general structure:



(Structure IV)

wherein X is selected from the group consisting of F (fluoro), CN (cyano), OCF_3(trifluoromethoxy), and NSC(isothiocyanate);

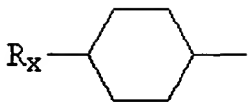
T_1 is a triple bond;

Y_1 and Y_2 are a pair of substituents selected from the group consisting of H and F, and $Y_1 = Y_2$;

Z_1 and Z_2 are a pair of substituents selected from the group consisting of H and F, and $Z_1 = Z_2$; and,

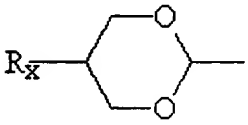
at least one of the pairs Y_1 and Y_2 and Z_1 and Z_2 are substituted with F;

Rn is selected from the group consisting of an alkyl group having the general formula C_nH_{2n+1}, an alkenyl group having the general formula C_nH_{2n-1}, an alkoxy group having the general formula OC_nH_{2n+1}, an alkenoxy group having the general formula OC_nH_{2n-1}, a group of the general structure



(Structure VI)

and a group of the general structure



(Structure VII)

wherein R_x for both structures is selected from a group consisting of an alkyl group having the general formula C_xH_{2x+1}, an alkenyl group having the general formula C_xH_{2x-1}, an alkoxy group having the general formula OC_xH_{2x+1}, and an alkenoxy group having the general formula OC_xH_{2x-1}.

2. A liquid crystal compound as set forth in claim **1**, wherein X is substituted with F; and, Y_1 and Y_2 are substituted with F and Z_1 and Z_2 are H groups.

3. A liquid crystal compound as set forth in claim **1**, wherein R_n is selected from a group consisting of an alkyl group having the general formula C_nH_{2n+1}, an alkenyl group having the general formula C_nH_{2n-1}, an alkoxy group having the general formula OC_nH_{2n+1}, and an alkenoxy group having the general formula OC_nH_{2n-1} where n is approximately 2 to 12.

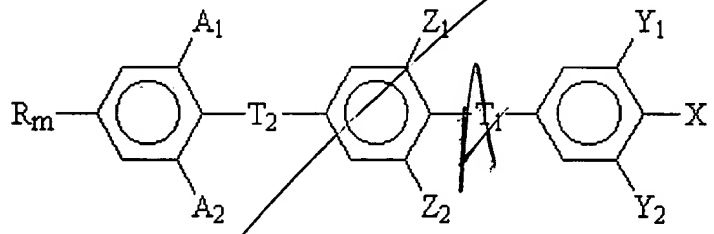
4. A liquid crystal compound as set forth in claim **1**, wherein R_x is selected from a group consisting of an alkyl group having the general formula C_xH_{2x+1}, an alkenyl group having the general formula C_xH_{2x-1}, an alkoxy group having the general formula OC_xH_{2x+1}, and an alkenoxy group having the general formula OC_xH_{2x-1} where x is approximately 2 to 12.

5. A liquid crystal compound as set forth in claim **1**, wherein R_n is an alkenyl group having the general formula C_nH_{2n-1}.

6. A liquid crystal compound as set forth in claim **1**, wherein R_n is an alkenyl group having the general formula C_nH_{2n-1} where n ranges approximately from 2 to 12.

7. A liquid crystal compound as set forth in claim **1**, wherein R_n is an alkenyl group having the general formula $C_xH_{2x-1}CH{=}CH\text{-}(CH_2)\text{-}$.

8. Liquid crystal compounds having the general structure



(Structure V)

wherein X is selected from the group consisting of F (fluoro), CN (cyano), OCF_3(trifluoromethoxy), and NSC(isothiocyanate);

T_1 is selected from the group consisting of a triple and a double covalent bond between two carbons;

T_2 is selected from the group consisting of a triple and a double covalent bond between two carbons; and,

T_1 is not equal to T_2 when T_1 or T_2 is a double bond;

Y_1 and Y_2 are a pair of substituents selected from the group consisting of H and F and $Y_1 = Y_2$;

Z_1 and Z_2 are a pair of substituents selected from the group consisting of H and F and $Z_1 = Z_2$;

A_1 and A_2 are a pair of substituents selected from the group consisting of H and F and $A_1 = A_2$;

at least one of the pairs Y_1 and Y_2, Z_1 and Z_2, and A_1 and A_2 is substituted with F; and,

R_m is selected from the group consisting of selected from a group consisting of an alkyl group having the general formula C_mH_{2m+1}, an alkenyl group having the general formula C_mH_{2m-1}, an alkoxy group having the general formula OC_mH_{2m+1}, and an alkenoxy group having the general formula OC_mH_{2m-1}.

NC 9. A liquid crystal compound as set forth in claim **8**, wherein X is a substituted with F;

Y_1 and Y_2 are substituted with F; and,

Z_1 and Z_2 and A_1 and A_2 are H groups.

10. A liquid crystal compound as set forth in claim **8**, wherein T_1 and T_2 are triple bonds between two carbons.

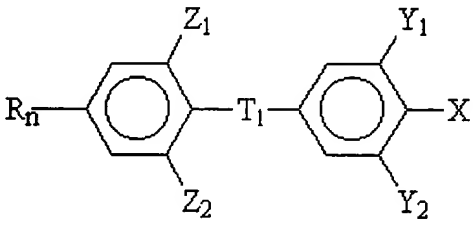
11. A liquid crystal compound as set forth in claim **8**, wherein R_m is selected from a group consisting of an alkyl group having the general formula C_mH_{2m+1}, an alkenyl group having the general formula C_mH_{2m-1}, an alkoxy group having the general formula OC_mH_{2m+1}, and an alkenoxy group having the general formula OC_mH_{2m-1} where m is approximately 2 to 12.

12. A liquid crystal compound as set forth in claim **8**, wherein R_m is an alkenyl group having the general formula C_mH_{2m-1}.

13. A liquid crystal compound as set forth in claim **8**, wherein R_m is an alkenyl group having the general formula C_mH_{2m-1} where m ranges approximately from 2 to 12.

14. A liquid crystal compound as set forth in claim **8**, wherein R_m is an alkenyl group having the general formula $C_mH_{2m-1}CH=CH-(CH_2)-$.

15. A eutectic mixture of liquid crystal compounds comprising at least two liquid crystal compounds, including at least one compound having the general structure



(Structure IV)

wherein X is selected from the group consisting of F (fluoro), CN (cyano), OCF3(trifluoromethoxy), and NSC(isothiocyanate);

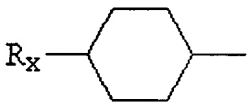
T_1 is a triple bond;

Y_1 and Y_2 are a pair of substituents selected from the group consisting of H and F and $Y_1 = Y_2$;

Z_1 and Z_2 are a pair of substituents selected from the group consisting of H and F and $Z_1 = Z_2$;

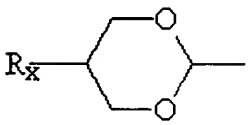
at least one of the pairs Y_1 and Y_2 and Z_1 and Z_2 are substituted with F;

R_n is selected from the group consisting of an alkyl group having the general formula C_nH_{2n+1}, an alkenyl group having the general formula C_nH_{2n-1}, an alkoxy group having the general formula OC_nH_{2n+1}, an alkenoxy group having the general formula OC_nH_{2n-1}, a group of the general structure



(Structure VI)

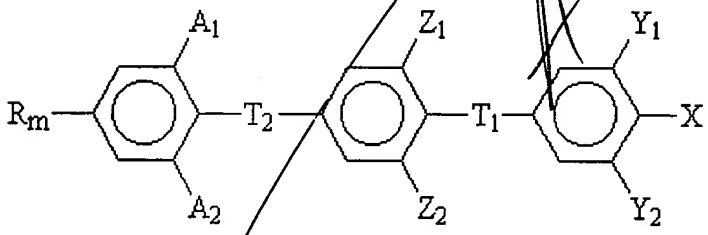
and a group of the general structure



(Structure VII)

wherein R_x for both structures is selected from a group consisting of an alkyl group having the general formula C_xH_{2x+1}, an alkenyl group having the general formula C_xH_{2x-1}, an alkoxy group having the general formula $-OC_xH_{2x+1}$, and an alkenoxy group having the general formula $-OC_xH_{2x-1}$.

16. A eutectic mixture of liquid crystal compounds comprising at least two liquid crystal compounds including at least one compound having the general structure



(Structure V)

wherein X is selected from the group consisting of F (fluoro), CN (cyano), OCF_3(trifluoromethoxy), and NSC(isothiocyanate);

T_1 is selected from the group consisting of a triple and a double covalent bond between two carbons;

T_2 is selected from the group consisting of a triple and a double covalent bond between two carbons; and,

T_1 is not equal to T_2 when T_1 or T_2 is a double bond;

Y_1 and Y_2 are a pair of substituents selected from the group consisting of H and F and $Y_1 = Y_2$;

Z_1 and Z_2 are a pair of substituents selected from the group consisting of H and F and $Z_1 = Z_2$;

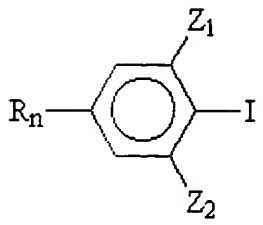
A_1 and A_2 are a pair of substituents selected from the group consisting of H and F and $A_1 = A_2$;

at least one of the pairs Y_1 and Y_2, Z_1 and Z_2, and A_1 and A_2 is substituted with F; and,

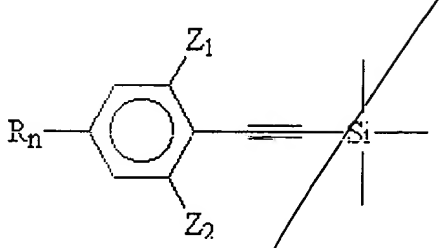
R_m is selected from the group consisting of selected from a group consisting of an alkyl group having the general formula C_mH_{2m+1}, an alkenyl group having the general formula C_mH_{2m-1}, an alkoxy group having the general formula OC_mH_{2m+1}, and an alkenoxy group having the general formula OC_mH_{2m-1}.

17. A method for preparing liquid crystal compounds, comprising the steps of:

a) reacting an iodobenzene as shown in Structure 1 with trimethylsilyl acetylene in the presence of a catalyst and an amine to produce an trimethylsilylacetyl derivative as shown in structure 2;



(Structure 1)

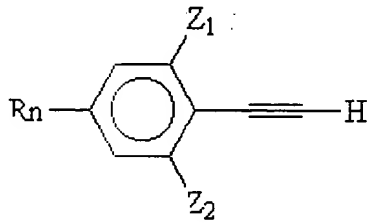


(Structure 2)

;

b) isolating the trimethylsilylacetyl derivative shown in structure 2 from the reaction of the iodobenzene shown in structure 1 and trimethylsilylacetylene in the presence of the catalyst and the amine;

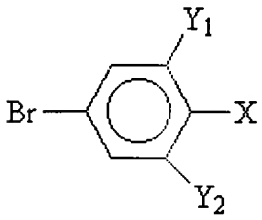
c) reacting the trimethylsilylacetyl derivative shown in structure 2 with a base to remove trimethyl silane and to give an unsubstituted product as shown in structure 3;



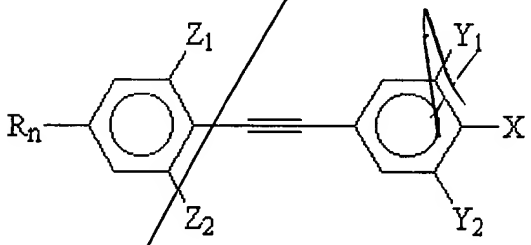
(Structure 3)

d) isolating the unsubstituted product as shown in structure 3 from the reaction of the trimethylsilylacetyl derivative shown in structure 2 with the base;

e) reacting the unsubstituted product as shown in structure 3 with a brominated, substituted benzene as shown in structure 3a to give a tolane product as shown in structure 4;



(Structure 3a)



(Structure 4)

f) isolating the tolane product shown in structure 4 from the reaction of the unsubstituted product as shown in structure 3 with the brominated, substituted benzene brominated, substituted benzene shown in structure 3a;

wherein X is selected from the group consisting of F (fluoro), CN (cyano), OCF_3(trifluoromethoxy), and NSC(isothiocyanate);

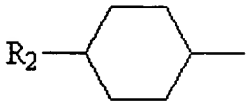
T_1 is a triple bond;

Y_1 and Y_2 are a pair of substituents selected from the group consisting of H and F, and $Y_1 = Y_2$;

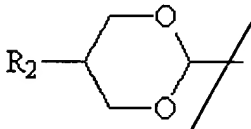
Z_1 and Z_2 are a pair of substituents selected from the group consisting of H and F, and $Z_1 = Z_2$; and,

At least one of the pairs Y_1 and Y_2 and Z_1 and Z_2 is substituted with F;

R_n is selected from the group consisting of an alkyl group having the general formula C_nH_{2n+1}, an alkenyl group having the general formula C_nH_{2n-1}, an alkoxy group having the general formula OC_nH_{2n+1}, an alkenoxy group having the general formula OC_nH_{2n-1}, a group of the general structure



and a group of the general structure



wherein R_x for both structures is selected from a group consisting of an alkyl group having the general formula C_xH_{2x+1}, an alkenyl group having the general formula C_xH_{2x-1}, an alkoxy group having the general formula OC_xH_{2x+1}, and an alkenoxy group having the general formula OC_xH_{2x-1}.

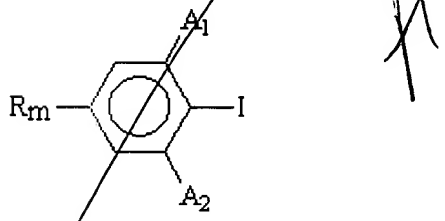
18. The method for preparing liquid crystal compounds as set forth in claim **17**, wherein the catalyst in steps a) and e) is $Pd(Ph_3)_2Cl_2/CuI$.

19. The method for preparing liquid crystal compounds as set forth in claim **17**, wherein the amine in steps a) and e) is triethylamine.

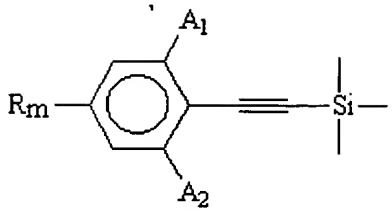
20. The method for preparing liquid crystal compounds as set forth in claim **17**, wherein the base in step c) is NaOH.

21. A method for preparing liquid crystal compounds, comprising the steps of:

a) reacting an iodobenzene as shown in Structure 5 with trimethylsilyl acetylene in the presence of a catalyst and an amine to produce an trimethylsilylacetyl derivative as shown in structure 6;



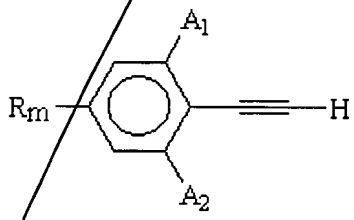
(Structure 5)



(Structure 6)

b) isolating the trimethylsilylacetyl derivative shown in structure 6 from the reaction of the iodobenzene shown in structure 5 and trimethylsilylacetylene in the present of the catalyst and the amine;

c) reacting the trimethylsilylacetyl derivative shown in structure 6 with a base to remove trimethyl silane and to give an unsubstituted product as shown in structure 7;

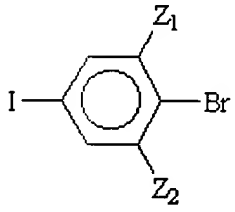


(Structure 7)

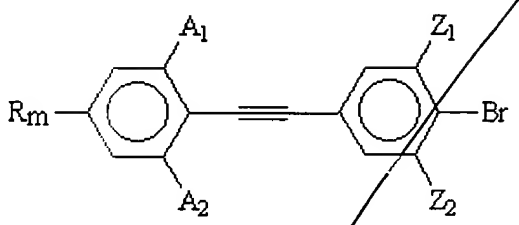
d) isolating the unsubstituted product as shown in structure 7 from the reaction of the trimethylsilylacetyl derivative shown in structure 6 with the base;

e) reacting the unsubstuted product as shown in structure 7 with a substituted bromoiodobenzene as shown in structure 7a in the presence of a catalyst, an

amine, and triphenylphosphine to prepare a brominated, substituted tolane product shown in structure 8;



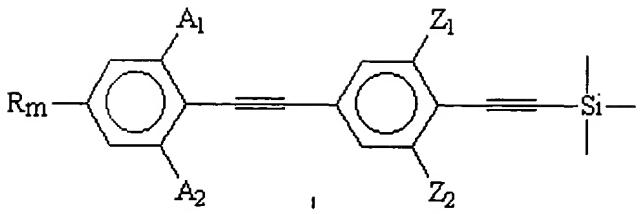
(Structure 7a)



(Structure 8)

f) isolating the brominated, substituted tolane product shown in structure 8 from the reaction of the unsubstuted product as shown in structure 7 with the substituted bromoiodobenzene as shown in structure 7a in the presence of the catalyst, the amine, and triphenylphosphine;

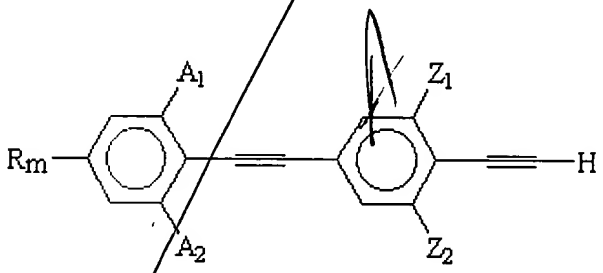
g) reacting the brominated, substituted tolane product shown in structure 8 with trimethylsilylacetylene in the presence of the catalyst, the amine, and triphenylphosphine to produce a trimethylacetyl derivative as shown in structure 9;



(Structure 9)

h) isolating the trimethylacetyl derivative shown in structure 9 from the reaction of the brominated, substituted tolane product shown in structure 8 with trimethylsilylacetylene in the presence of the catalyst, the amine, and triphenylphosphine;

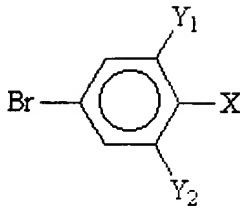
i) reacting the trimethylsilylacetyl derivative shown in structure 9 with a base to remove trimethylsilane and produce an unsubstituted product as shown in structure 10;



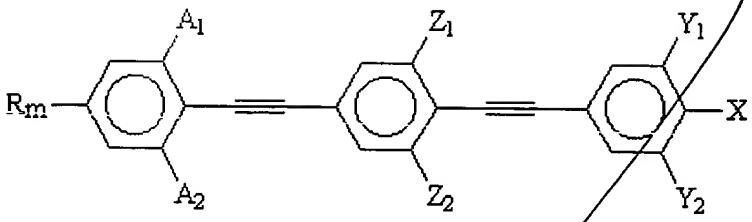
(Structure 10)

j) isolating the unsubstituted product shown in structure 10 from the reaction of the trimethylsilyl derivative shown in structure 9 with the base;

k) reacting the unsubstituted product shown in structure 10 with a substituted bromobenzene as shown in structure 10a in the presence of a catalyst, an amine, and triphenylphosphine to produce a bis-tolane product as shown in structure 11;



(Structure 10a)



(Structure 11)

l) isolating the bis-tolane product shown in structure 11 from the reaction of the unsubstituted product shown in structure 10 with the substituted bromobenzene shown in structure 10a in the presence of the catalyst, the amine, and triphenylphosphine;

wherein for the structures shown, X is selected from the group consisting of F (fluoro), CN (cyano), OCF_3(trifluoromethoxy), and NSC(isothiocyanate);

T_1 is selected from the group consisting of a triple and a double covalent bond between two carbons;

T_2 is selected from the group consisting of a triple and a double covalent bond between two carbons; and,

T_1 is not equal to T_2 when T_1 or T_2 is a double bond;

Y_1 and Y_2 are a pair of substituents selected from the group consisting of H and F and $Y_1 = Y_2$;

Z_1 and Z_2 are a pair of substituents selected from the group consisting of H and F and $Z_1 = Z_2$;

A_1 and A_2 are a pair of substituents selected from the group consisting of H and F and $A_1 = A_2$;

at least one of the pairs Y_1 and Y_2, Z_1 and Z_2, and A_1 and A_2 is substituted with F; and,

R_m is selected from the group consisting of selected from a group consisting of an alkyl group having the general formula C_mH_{2m+1}, an alkenyl group having the general formula C_mH_{2m-1}, an alkoxy group having the general formula OC_mH_{2m+1}, and an alkenoxy group having the general formula OC_mH_{2m-1}.

22. The method for preparing liquid crystal compounds as set forth in claim **21**, wherein the catalyst in steps a), e), g), and k) is $Pd(Ph_3)_2Cl_2$/CuI.

23. The method for preparing liquid crystal compounds as set forth in claim **21**, wherein the amine in steps a), e), g), and k) is triethylamine.

24. The method for preparing liquid crystal compounds as set forth in claim **21**, wherein the base in steps c) and i) is NaOH.